# Science Objectives of the Aerosols, Clouds, Convection, and Precipitation Millimeter- and Submillimeter-wave Radiometers

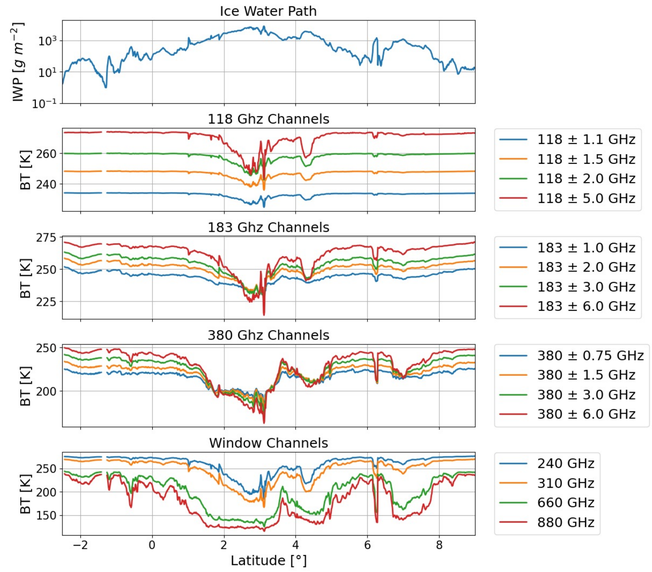
Ian S. Adams[1], S. Joseph Munchak[1*], Yuli Liu[2], Hélène Brogniez[3], F. Joseph Turk[4+], Ralf Bennartz[5], Matthew Walker McLinden[1], Laura Hermozo[6], and Gerald G. Mace[2]

[1]NASA GSFC, [2]University of Utah; [3]LATMOS, University of Paris Saclay, [4]JPL/Caltech, [5]Vanderbilt University, [6]CNES

*now with tomorrow.io; [+]The work by FJT was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with NASA. Government sponsorship acknowledged.

## OVERVIEW

To meet the science objectives related to clouds, convection, and precipitation, the Atmospheric Observing System (AOS), part of the Earth System Observatory (ESO), has been conceptualized to include two orbits. The first is a low inclination orbit focusing on convective dynamics, related clouds, and resulting aerosol processes. The other, in a sun-synchronous polar orbit, more broadly addresses AOS science goals, with the inclusion of aerosol and cloud radiative feedbacks and high-latitude processes. The baseline mission is expected to include radars, lidars, radiometers, polarimeters, and spectrometers across both orbits, and the team is working with international partners for potential contributed sensors, including tandem radiometers for the inclined orbit from the Centre National d'Etudes Spatiales (CNES). The radiometers in the inclined and polar orbits will contribute to liquid and ice cloud and precipitation science.



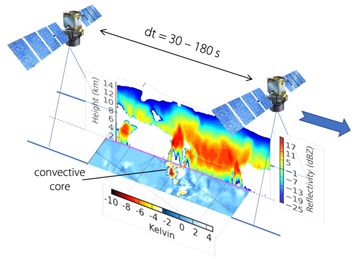

| Channel Definition | Frequencies | Radiometric Resolution | | SATM Drivers | Orbit Requirement |
|---|---|---|---|---|---|
| Surface Channel | 89–113 GHz x 1 | Baseline: 0.5 K | Threshold: 1.0 K | Surface precipitation<br>Liquid water path<br>Ice water path | Polar: Baseline<br>Inclined: Threshold |
| G-Band Water Vapor Channels | 183.31 GHz x 3<br>offset 1–11 GHz | Baseline: 1.0 K | Threshold: 1.5 K | Ice water path<br>Ice water content<br>Surface precipitation | Polar: Threshold<br>Inclined: Threshold |
| Low Submm Water Vapor Channels | 325.15/380.2 GHz x 3<br>**matched to 183 GHz** | Baseline: 1.5 K | Threshold: 2.0 K | Ice water path<br>Ice water content | Polar: Threshold<br>Inclined: Threshold |
| Ice Cloud Channel | 640–700 GHz x 1 | Baseline: 1.5 K | Threshold: 2.0 K | Ice water path<br>Ice water content | Polar: Threshold<br>Inclined: Baseline |
| Dual-Pol Ice Cloud Channel | 640–700 GHz x 1<br>matched, orthogonal | Baseline: 1.5 K | Threshold: 2.0 K | Ice water path<br>Particle shape | Polar: Baseline<br>Inclined: Baseline |
| G-band Window Channel(s) | 150–170/210–240 GHz x 1<br>(or 2 orthogonal) | Baseline: 1.0 K | Threshold: 1.5 K | Ice water path<br>Surface precipitation<br>Liquid water path | Polar: Baseline<br>Inclined: Nice to have |
| Dual-Pol Surface Channel | 89–113 GHz x 1<br>matched, orthogonal | Baseline: 0.5 K | Threshold: 1.0 K | Surface precipitation<br>Liquid water path<br>Ice water path | Polar: Nice to have<br>Inclined: Baseline |
| mmWave Oxygen Channels | 118.75 GHz x 3<br>±1, ±1.5, and ±2 GHz | Baseline: 0.5 K | Threshold: 1.0 K | Ice water path<br>Surface precipitation | Polar: Nice to have<br>Inclined: N/A |
| High Ice Cloud Channel | 820–890 GHz x 1 | Baseline: 1.5 K | Threshold: 2.0 K | Ice water path<br>Ice water content | Polar: Nice to have<br>Inclined: N/A |

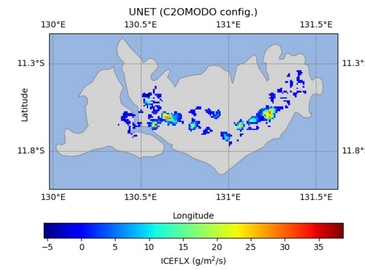
Inclined Minimum

Polar Minimum

## TANDEM RADIOMETERS

The notional configuration for the inclined orbit includes a pair of tandem radiometers contributed by CNES. In addition to directly addressing AOS science objectives, the tandem radiometers will provide time-resolved changes in brightness temperature that are sensitive to vertical ice mass flux associated with convection.




## PRECIPITATION RECORD

The suite of sensors, specifically multi-frequency radars and radiometers, will extend and enhance the global precipitation record started under the Tropical Rainfall Measurement Mission (TRMM) and continued by the Global Precipitation Measurement (GPM) mission. The virtual constellation of passive microwave radiometers, complemented with infrared observations, provides global maps of precipitation rate at 30 minute temporal resolution and 10 km spatial resolution. Data collected by AOS will improve estimates of ice phase precipitation.

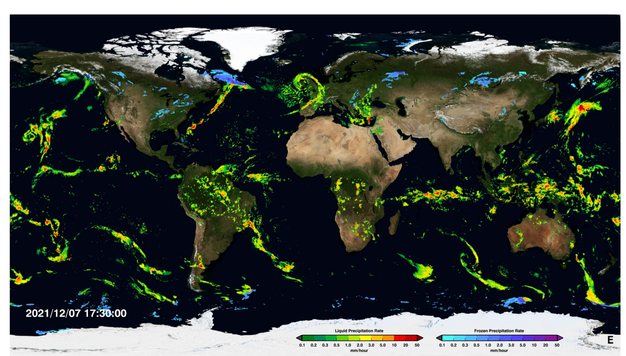



image source: https://gpm.nasa.gov/data/imerg#latesthalf-hourlyimage